Mixing Zones for Stormwater:
Status, Issues & Development

2003 Stormwater Permit
Conference of Washington

CH2MHILL

Mixing Zones for Stormwater

- Basis of Mixing Zones
- Status of Stormwater Mixing Zones
- Mixing Zone Certification
- Documenting Mixing Zones
- Mixing Zones in Streams & Estuaries

Basis of Mixing Zones

- Region near discharge to allow dynamic mixing of discharge with ambient receiving waters (area of non-compliance with WQS)
- EPA guidance for Clean Water Act recognizes mixing zones for acute & chronic chemical criteria & toxicity
- WAC 173-201A-400 specifies conditions that allow mixing zones and defines parameters by receiving waters

Stormwater Mixing Zones Status

- June 2003 PCHB ruling -- standard mixing zones & process for granting them in Industrial SW General Permit (ISWGP) was not valid
- PCHB ruling -- limits ISWGP mixing zones to a case-by case basis through application process (under appeal)
- Ecology response – appealing ruling, may have to develop guidance for some ISWGP permittees and some could remain case-by-case

SW Mixing Zones Certification

- Document that appropriate BMPs are applied for discharge constituents & SWPPP implemented
- Proposed mixing zone will not create barrier to migration or displacement of indigenous organisms
- Proposed mixing zone will not have reasonable potential for loss of sensitive habitat, interfere with uses of water body, affect public health
- Discharge does not include parameter for listed waterbody
- Dilutions may be limited by TMDL

Key Water Quality Issues

- Habitat protection
- Salmonids and other listed aquatic species
- Temperature
- Metals (water & sediments)
- Nutrients
- Dissolved oxygen
- Bacteria
- Bioaccumulative chemicals
- Instream Flow

Step to Documenting Mixing Zones

1) Compile & Summarize Available & Collected Information
2) Model or Test Discharge Mixing
3) Report Information to Ecology
4) Discuss Details for Permit

Document Mixing Zones - Data

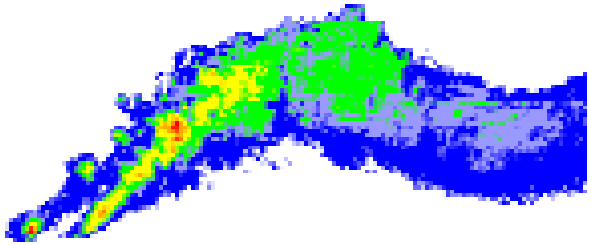
- Details of discharge location - physical layout, bank or bottom conditions
- Discharge characteristics - diameter, depth or elevation, seasonal flows, chemistry
- Receiving waters - flow regime, background seasonal conditions (temperatures, DO, pH, hardness, metals) - as available
- Habitat and biological resources - migratory and resident aquatic species, and habitat conditions - as available
- History of existing stormwater discharge

Document Mixing Zones - Model or Test

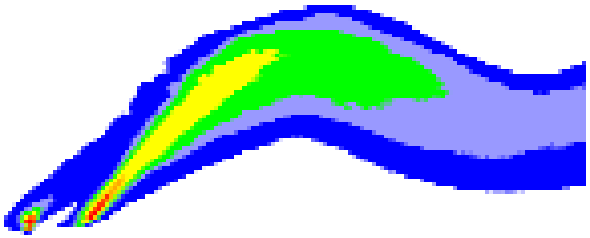
- Modeling of surface or submerged discharges using agency-approved models
- Model selection critical for site-specific representation
- Field tracer tests used in place of model or used to verify models, when needed
- Modeling = “Devil is in the details”

Model-predicted versus Actual Dilutions

- Mixing process is dynamic
- Models show average
- Mixing changes continuously
- Field data key for complex discharge sites



Instantaneous

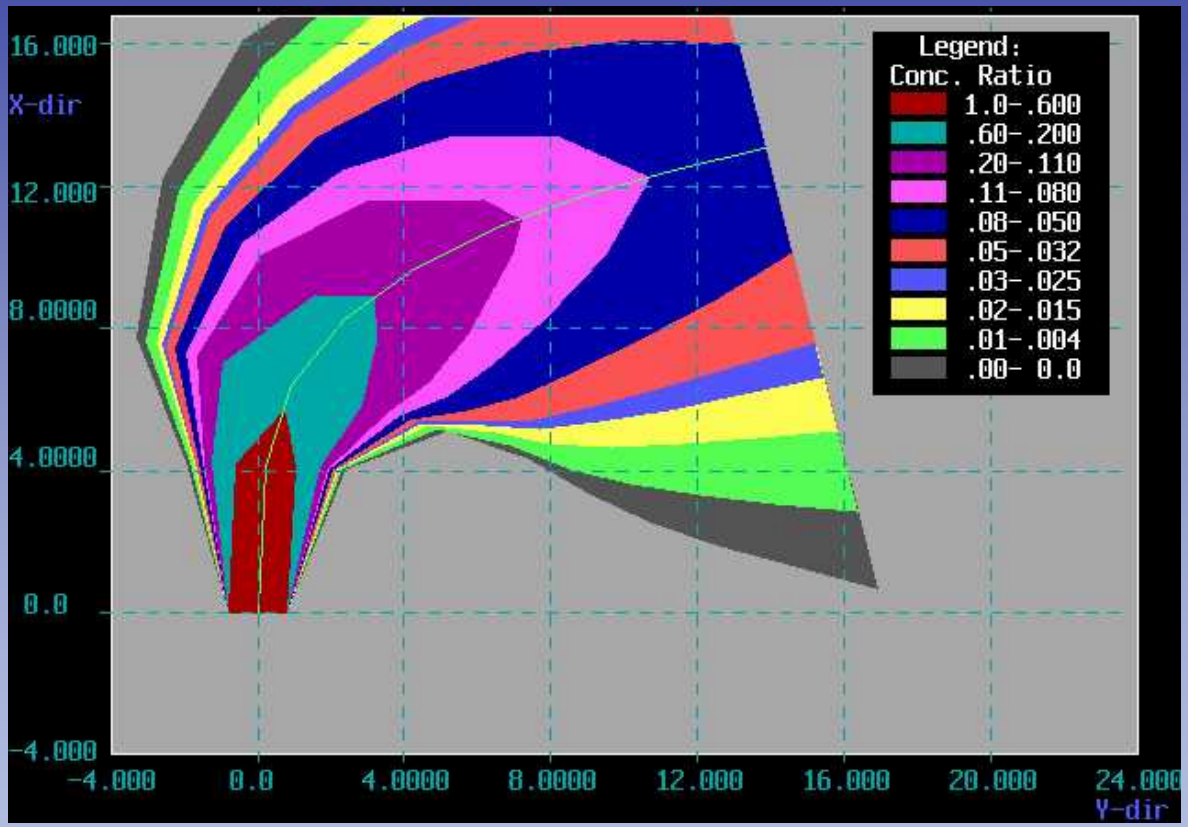


Time averaged

Laser-induced fluorescence images of merging buoyant jets in density-stratified crossflow

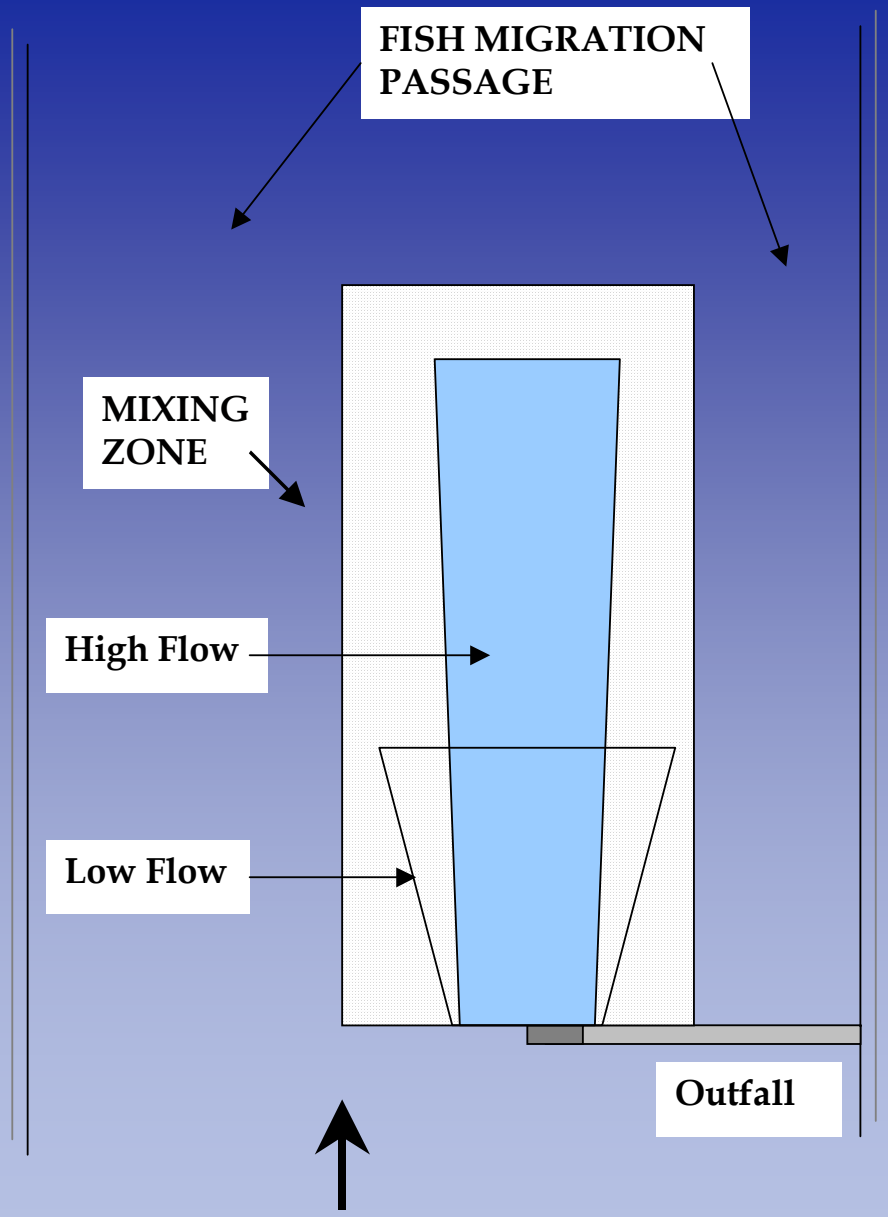
Shoreline Discharge to River

- Discharge outlet velocity, distance from bank, and ambient currents determine plume behavior
- Bank attachment reduces mixing
- Volume and width of river available limited to 25%



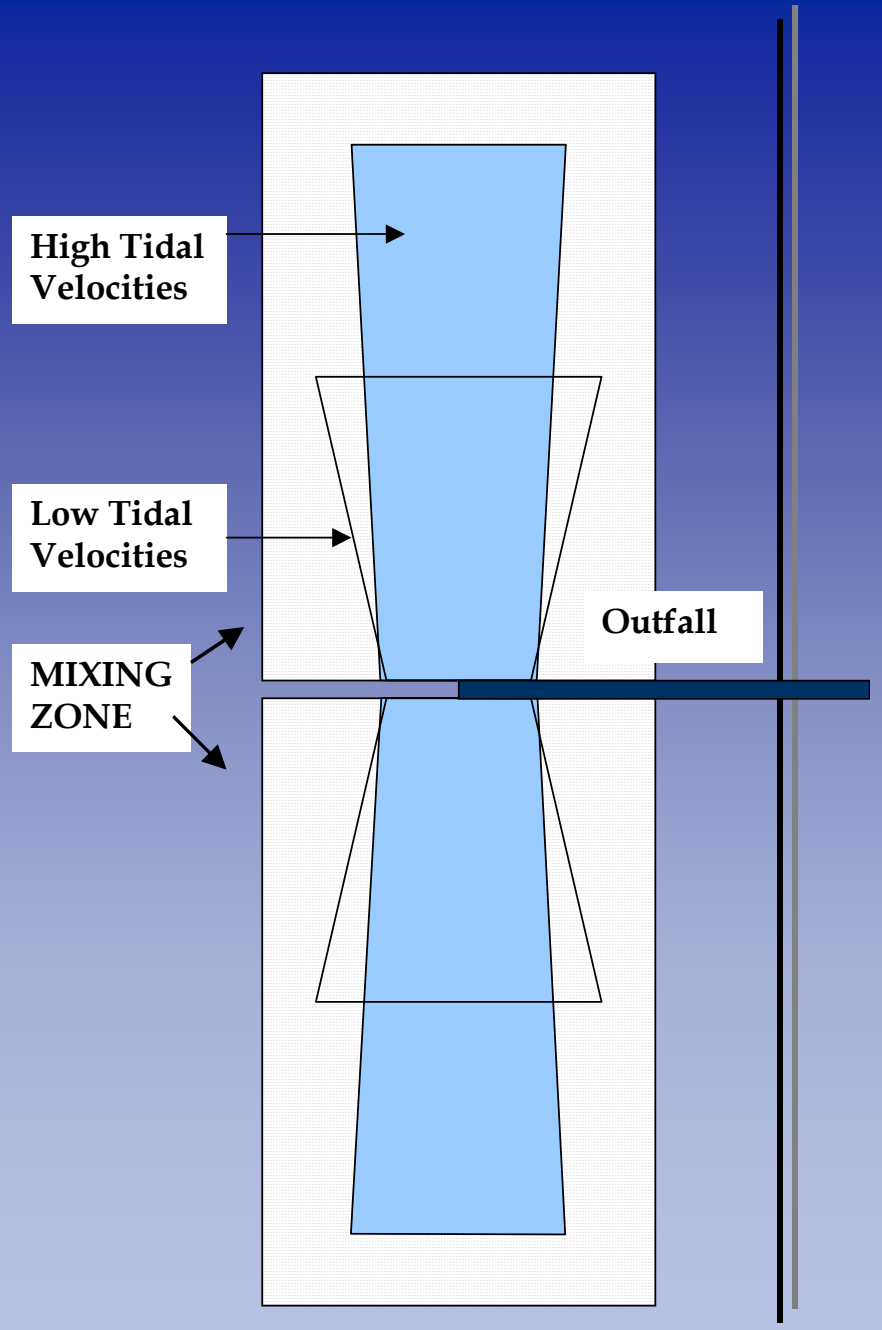
Mixing Zone Design Elements in Rivers

- River width limits
- Accommodate fish passage requirements
- Low river flow plume width
- High river flow plume length
- Allow for lateral plume movement for flow range



Mixing Zone Design Elements in Estuaries

- Site-specific currents
- Seasonal & tidal water column stratification
- Accommodate fish passage requirements
- Allow for plume movement during tidal reversal



Mixing Zones and Dilution Performance are Key to NPDES Issues

- Discharge port diameter, coupled with water depths and velocities determine dilution performance
- Mixing Zones may need site-specific development to minimize potential for near-field impacts

Next Steps for Stormwater Mixing Zones

- Ecology guidance to define mixing zones for some categories of discharges under the ISWGP
- Mixing Zone Certification for some specific discharges - dependent on the industry category or SW constituents?
- Legal appeals and decisions